



YAHARA RIVER/LAKE MONONA WATERSHED (LR08)



*A bioswale for stormwater,
an alternative to reduce
urban runoff*

This watershed has been a nonpoint source priority watershed project since 1989. The three major goals of the project are: reduce heavy metal loading to surface waters; reduce suspended solids loads to reduce sedimentation in streams and lakes; and reduce phosphorus loading to Lakes Monona and Waubesa. The Dane County Regional Planning Commission prepared the appraisal monitoring report (1990) and priority watershed project plan (1992). These documents contain nonpoint source monitoring and management recommendations for most lakes and streams. Implementation of the plan's recommendations have been ongoing since 1992.

About 70% of the watershed's 85 square miles is considered urban and the water quality of its lakes and streams reflects this with corresponding urban runoff (i.e., nutrients, solids, organic contaminants, heavy metals, oil and grease, etc.). In particular, nutrients, sediment, and contaminants attached to the sediment are delivered to lakes Monona and Waubesa from Lake Mendota's watersheds via the Yahara River.



*A typical salt storage
facility*

The principal groundwater concern is the decrease in groundwater levels due to urban pumping and increasing numbers of impervious surfaces that limit surface water infiltration. Both of these changes affect base flow and thus water temperature and quality in streams. In addition, elevated chloride and sodium levels in surface water and groundwater exist due to winter road and street salting.

A 1995 study of salt use in 35 municipalities indicated that only six municipalities have written salt use policies, and of those, only four specifically mention salt use reduction as a goal (WDNR, 1996). Now most local officials are, however, aware that the use of chlorides can impair water quality and are an increasing concern in the Yahara System.

Table 1Municipalities in the Yahara River/Lake Monona Watershed

Municipality	Watershed Numbers	Co.	1995 Population	2000 Population	Percent Growth 1995 - 2000
C. Madison	LR08, LR09, LR10	Dane	199,518	208,054	4.3
C. Fitchburg	LR08	Dane	17,266	20,501	18.7
C. Monona	LR08	Dane	8,548	8,018	-6.2
V. McFarland	LR 06, 08	Dane	5,736	6,416	11.9
T. Dunn	LR08	Dane	5,417	5,270	-2.7

Municipality	Watershed Numbers	Co.	1995 Population	2000 Population	Percent Growth 1995 - 2000
T. Burke	LR08, LR09	Dane	3,175	2,990	-5.8
T. Blooming Grove	LR08	Dane	2,085	1,768	-15.2

As the chart above shows, the cities of Madison and Fitchburg and the village of McFarland show no signs of slowed growth. The rapid growth in these municipalities is reflected in increasing urban runoff and hydrologic modifications in the watershed(s). The entire Dane County portion of the Yahara Lakes basin is affected by the tremendous growth and suburbanization taking place in the Madison area watersheds LR08, LR09, and LR10. This continued expansion underscores the need for full implementation and enforcement of construction site erosion and stormwater management controls. So far, the cities of Fitchburg, Madison, Middleton, Stoughton, Sun Prairie, and the villages of McFarland and Oregon have enacted ordinances developed after model erosion and stormwater control ordinances (note Middleton, Stoughton, Sun Prairie, and Oregon are not located in this watershed).

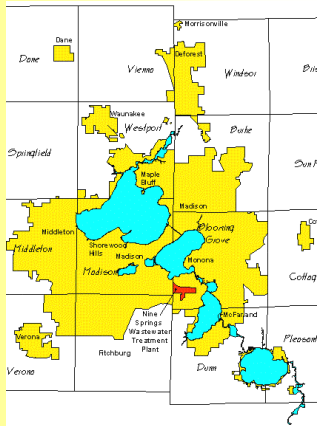


Shoreline development

Dane County is the principal designated management agency for controlling erosion in unincorporated areas of this watershed within Dane County. In 1995-1996, Dane County expanded its erosion control requirements to include not only subdivision plats, but also most large-scale nonagricultural nonresidential developments. The county also has a principal role in regulating wetland, floodplain and shoreland protection programs as it is responsible for the administration of floodplain and shoreland zoning in unincorporated areas. Further, through its zoning powers, the county, working with towns, may place wetlands or other sensitive areas in a "conservancy" zoning classification.

Madison Metropolitan Sewerage District (MMSD)

MMSD serves the entire Madison metropolitan region with its direct discharge and pretreatment programs. The district's operations have undergone nine substantial upgrades, the ninth addition, which includes a new ultraviolet disinfection system and biological phosphorus removal, was completed in 1997. A 1996 inspection found MMSD in substantial compliance with its permit. The plant has a design load of 50 million gallons per day (mgd). In 1993 Verona was annexed into MMSD; the Verona wastewater treatment plant was operated by MMSD from January 1995 through July 1996, when connection of Verona's flow to the Nine Springs Wastewater Treatment Plant was completed. Beginning in the summer of 1998, MMSD will return a volume of effluent to Badger Mill Creek that is equal to the volume of wastewater pumped out of the Sugar River Basin and treated at the Nine Springs Wastewater Treatment Plant. MMSD has worked with WDNR and other stakeholders to develop a mutually agreeable plan for managing this effluent return program (MMSD). The plant currently discharges to an effluent ditch via an underground pipe from the Nine Springs plant about five miles away, at an average rate of 36-37 mgd.



MMSD service area. The Nine Springs Wastewater Treatment Plant is highlighted in red.

From the 1940s through late 1993, sludge produced at the Nine Springs Wastewater Treatment Facility was discharged to a 130-acre lagoon system adjacent the facility. Storage tanks constructed in 1993 eliminated the need for lagoon storage of newly produced sludge.



PCB Corner

- PCB (polychlorinated biphenyls) are manmade chemical compounds that have one or more chlorine atoms attached to a biphenyl molecule (a dual carbon ring structure). There are 209 different congeners (structures) of PCBs, depending on the number of chlorine atoms and where they attach on the carbon rings.
- This compound is very toxic and is persistent in the environment.
- PCBs can cause cancer in animals and can *potentially* cause cancer in people.
- Some PCBs can alter reproductive processes in mammals, sometimes at doses too low to cause other signs of toxicity.
- PCBs bioaccumulate in fat tissues, are toxic to fish, and can impair reproductive success in birds and mammals.
- For more info visit: www.epa.gov/toxtea/m/pcb/defs.htm

During the 1970s MMSD began evaluating alternative sludge handling options. In 1974, the district initiated the Metrogro Program, which recycles sludge by spreading it on agricultural land as a fertilizer and soil conditioner. In the 1980s, routine monitoring resulted in the discovery that isolated segments of the lagoon system contained sludge with (polychlorinated biphenyl) PCB concentrations in excess of 50 ppm, which is the upper limit for unrestricted land application.

The lagoon system was placed on the U.S. Environmental Protection Agency's Superfund site list in 1990. EPA agreed that sludge with PCB concentrations below 50 ppm could continue to be used in the Metrogro Program since this material met all regulatory limits. MMSD has instituted a lagoon cleanout/closure program for those portions of the lagoon system containing sludge with PCB concentrations of less than 50 ppm. This work should be completed by the year 2000.

A Remedial Investigation was completed in 1995 as part of Superfund-related activities and demonstrated the PCBs were not moving off site. PCB concentrations at the lagoon site ranged from approximately 1 ppm to 170 ppm, with an average concentration of 30 ppm. In 1997, EPA issued a Record of Decision for the site. The decision called for in-place consolidation and containment of all sludge with PCB concentrations at or above 50 ppm, with a cover being constructed over the containment area. EPA approved the remedial design document and associated work plans in December, 1997. Construction activities began in January 1998 and are limited to the winter months due to design considerations. Construction is expected to be completed by the year 2000.

MMSD managed high flows during the heavy precipitation of spring and summer of 1993 and summer of 1996 through overflow to Nine Springs Creek. Overflow to Nine Springs Creek is under negotiation with WDNR through the Upper Sugar River Initiative.

Priority Watershed Program Projects

Grants to the cities of Madison, Monona and Fitchburg and the village of McFarland in 1995 and 1996 through the priority watershed project have funded a number of activities to benefit water quality, including the following projects by the city of Monona: innovative stormwater outlet design at Interlake Park; stormwater management training; storm sewer outfall inventory; development of Monona wetland conservancy ponds; Winnequah Park shoreline stabilization; acquisition of the Sand County Wetland; and stormwater sampling to evaluate the effectiveness of best management practices.

The cities of Madison, Fitchburg and McFarland also actively participates in the priority watershed project and are currently working on the following projects: restoration of and sediment demonstration project on Starkweather Creek; development of an outlet structure for lowering the water level of Dunn's Marsh to maintain the wetland's natural hydraulics and functional values (despite increasing stormwater flows); development of stormwater buffers adjacent to Edna Taylor Marsh; Cottage Grove Road/Highway 51 stormwater management plan; Wingra Creek streambank stabilization project; the Jenni-Kyle channel stabilization project; and a pilot street sweeping project for stormwater quality improvements. Results from the pilot street sweeping project indicate reductions in suspended solids and the heavy



Street sweeping

metals cadmium, chromium, copper and lead from pre-sweeping stormwater to post-sweeping stormwater (Interdepartmental Parking Team).

The cities of Fitchburg and Madison are cooperating on the Dunn's Marsh project. Fitchburg has installed wet ponds in a number of locations and has done stormwater planning in developing areas of the city with assistance from the priority watershed project. McFarland has also put in some wet ponds and has put in place a stronger erosion control stormwater management ordinance. McFarland is a great example to-date of a smaller community successfully managing erosion within its boundaries, showing that even smaller communities can manage erosion.

STREAMS

Yahara River The Yahara River serves as relatively short connecting channel between lakes in this watershed. The segment between Lake Mendota and Lake Monona is adversely affected by sediments, debris and nutrients from Madison streets, parking lots and yards washing into the river and eventually to Lake Monona. As a "channel," this segment receives tremendous boating pressure. Between Lake Monona and Upper Mud Lake, the Yahara has many of the same pollutant sources and exhibits the same poor water quality as in the Mendota-Monona segment.



Algae choked creek

Murphy (Wingra) Creek is a two-mile channelized stream, with an 8.6 square mile watershed, and connects Lake Wingra with Lake Monona. Murphy Creek (commonly called Wingra Creek) is often choked with weeds and is periodically stagnant due to low base flow conditions and a flat gradient of 2 feet/mile. The stream's channelization started in 1905. Water quality is poor due to urban runoff, aquatic plant growth and sedimentation. Low dissolved oxygen levels and extreme diel fluctuations from the respiration of an excessive number of aquatic plants results in occasional fish kills. Chloride levels are high, principally due to street runoff of road salt. The water is very turbid. In the past, manure from livestock holding pens at the Dane County Fairgrounds washed into Murphy Creek via storm sewers. A major fishkill in 1977 was partly caused by runoff from the fairgrounds. Heavy metals, DDT metabolites, and PCBs have been detected in sediment samples taken from the creek. Despite these problems the creek seasonally supports good populations of bluegills and forage fish. Walleye and northern pike are also present during spawning. The creek is classified as a warm water sport fishery and is a popular fishing and canoeing water.

The city of Madison has designed and implemented during 1996 a streambank stabilization project on the creek between Fish Hatchery Road and Park Street. A bike path travels the length of Wingra Creek, which makes it highly accessible. The potential for recreational use of the creek is very high. WDNR and the city of Madison may work together to enhance the creek's habitat. A central issue for improving the creek's water quality and fisheries value is restoring the creek's water levels by minimizing human-induced fluctuations.

Murphy's Creek This three-mile-long spring-fed creek is a tributary to Lake Waubesa at its southwestern shore. This creek's sub-watershed has a large proportion of wetland to total



Northern pike

surface area. The South Waubesa Wetlands is the largest wetland area Murphy's Creek flows through; much of the wetland is managed by the Nature Conservancy and WDNR. The smaller wetland units upstream of South Waubesa contain springs, but have been affected and are still threatened by subdivision development and agricultural runoff. Flow in the creek is generally low. Until 1983, water quality was affected by discharges from the Oakhill Correctional Institute. Since then, the institute has been hooked up to the Oregon wastewater treatment plant. Appraisal monitoring in 1990 indicated good water quality. Groundwater seepage and protection offered by the wetlands contribute to good water quality and habitat in the lower portions. Water quality and habitat are limited in the upper reaches by low flow, as is the creek's fishery, which is limited to forage species due to the low flows.

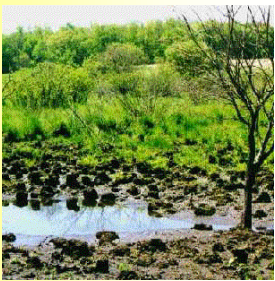
The potential for good northern pike habitat exists in this creek but fluctuating water levels on Lake Waubesa, as on other Madison Lakes, precludes successful spawning. Northern pike need flooded mats of grasses and sedges on which to lay eggs. Vegetation mats are necessary as the eggs do not cling to plants. Thus, lake level drawdowns and removal of vegetation (grass, sedges) inhibits this creek from meeting its full fishery potential.



Nine Springs Creek

Nine Springs Creek is six-miles long and is intermittent until just east of Fish Hatchery Road where it picks up flow from the springs that give the stream its name. It empties into the Yahara River just above Upper Mud Lake. Portions of the stream have been ditched and straightened, and the stream runs through an urbanizing area. Sediment is delivered to the stream from farm fields to the south and from construction sites in the cities of Fitchburg and Madison and their sub-watersheds. Channelization has increased summer water temperatures, reduced habitat, and increased sedimentation and excessive growth of aquatic plants (Marshall, 1990).

A Dane County Highway Department project in Fitchburg resulted in heavy sediment loading to the creek during the summer of 1989. The creek's heavy sediment load results in the lower portion occasionally requiring dredging. Urban storm water from the cities of Fitchburg and Madison also deliver pollutants to the creek. As the upper portions of the sub-watershed continue to be developed, this problem is expected to increase. These factors, plus its low gradient, cause "fair" water quality, with channel straightening having a devastating effect on water quality and habitat.



A small spring in a sedge meadow

Detectable levels of mercury have been found in low concentrations in Nine Springs sediment taken at Moorland Road. The Madison Metropolitan Sewerage District (MMSD) sludge lagoons are adjacent to the stream. One of these lagoons is Superfund site. Citizens have raised concerns about the possibility of toxic substances leaking from the lagoons into Nine Springs Creek and Lake Waubesa. However, the possibility of mercury and other substances moving from the lagoon was evaluated in the Remedial Investigation (RI) conducted as part of the Superfund evaluations for the lagoon site. The RI report, which was approved by the U.S. Environmental Protection Agency in 1995, concluded that no sludge constituents are migrating through the lagoon dike walls; no patterns between sludge and sediment constituents were found to indicate possible migration; the peat acts as a capture zone that restricts migration of sludge constituents to the aquifer beneath the lagoons; and groundwater is not affected by the lagoon sludge constituents (MMSD).



Dogwood Spring

In 1996 the city of Fitchburg commissioned a private consultant to work with staff and the Nine Springs Neighborhood Plan Steering Committee to prepare a long-range land use and circulation plan for the Nine Springs Neighborhood. In addition, the 1996 UW-Madison's Water Resources Management Workshop, using a Lake Planning Grant from the WDNR, conducted a scoping study of the Nine Springs E-Way, including hydrologic monitoring and modeling and the identification of critical areas for protection, restoration and/or enhancement of the area's unique springs system (UW-Madison). In 1996 the Nine Springs Network (NSN), a grassroots watershed organization, was formed to protect the E-Way and the creek springs against developmental pressures.

Starkweather Creek is a tributary to Lake Monona at its north end, draining urban land on the east side of Madison. The majority of wetlands in the watershed have been drained or filled for urban development. The creek has been extensively channelized and water quality in the main stem and the east and west branches is very poor. The lower reach of Starkweather, below the confluence of the East and West branches, is very turbid and essentially a stormwater channel for the east side of Madison. The stream bottom and shoreline are choked with sediment and debris.



West Branch of Starkweather Creek: Up to the 1960s and early '70s, the West Branch of Starkweather Creek received intensive point source discharges of many different toxic substances. Some of these discharges remain in the sediment of the creek and continue to pose problems for fish and aquatic life. While the point source dischargers have been managed through various programs, some former industrial sites continue to pose problems for the creek's water quality. WDNR and the city of Madison have, however, dredged a portion of the west branch of the creek to reduce problems.



Runoff from parking lots (above) makes its way to our streams (below) and water resources.

The West Branch drains the area around the Dane County Regional Airport, a portion of the east side of Madison, and urbanizing areas north of U.S. Highway 151. Contaminants in the runoff include oil, grease, lead, cadmium, ethylene glycol and polyaromatic hydrocarbons from streets, parking lots, Truax Field and Dane County Regional Airport, roofs, and other impervious surfaces. Other known contaminants present in the river include lead, zinc, PCBs, and DDT metabolites. In 1990 major spills in runoff from the airport elevated levels of biochemical oxygen demand in the river. The source was found to be the de-icer ethylene glycol, which commonly ponded below storm sewer pipes draining the runways. Subsequently, the airport has constructed a \$1 million ethylene glycol collection system for ultimate discharge to Starkweather Creek (Marshall, 1993).

A large portion of the West Branch watershed's undeveloped area is changing due to a major commercial development at the intersection of U.S. Highway 151 and Interstate 90-94. This development will likely cause significant sediment loading to the West Branch during construction and increased urban stormwater loading after construction, unless adequate erosion control and stormwater management measures are taken. Unlike the East Branch, in the West Branch aquatic plants are scarce and the stream does not experience wide diel (24-hour) dissolved oxygen fluctuations.



Walleye

East Branch of Starkweather Creek: The East Branch of Starkweather Creek drains the east side of Madison south of U.S. 151 (East Washington Ave.) and rural land east of Interstate 90-94. This stream is best described as an urban stormwater ditch choked with sediment and aquatic vegetation. Severe diel (24-hour) dissolved oxygen fluctuations are common during low flow summer periods. Fish populations vary during the year, reflecting seasonal migrations and low summer dissolved oxygen levels. In the past this branch received industrial effluent high in ammonia and other toxic substances. One of the stream's remaining natural attributes, an area of springs just west of the Interstate, is threatened by commercial development. A streambank stabilization and wetland restoration proposal (Mead & Hunt) indicates that past channelization and ditching of this segment has simplified adjacent wetland functional values but that certain features could be restored by hydraulic modifications and vegetational landscaping work.

Starkweather Creek Main Stem: Toxic constituents, PCBs, mercury, lead and zinc, have been detected in the sediment of the stream's main stem. Increased runoff from development and expansion of impervious surfaces in the upper watershed has raised concern about potential flushing of contaminated sediments into Lake Monona. Starkweather Creek fish samples were collected during the summer of 1991 for PCB sampling and in 1995 for mercury.

WDNR conducted a remedial demonstration project to address in-place pollutants in stream sediments. Portions of the stream were dredged, the spoils disposed of, and the banks stabilized and revegetated. WDNR worked with the city of Madison, Dane County, and local interest groups on this project, with the goals of improving water quality and recreational use of the lower reaches of the stream, as well as removing the contaminated sediments in the stream contributing to the fish consumption advisory for Lake Monona walleye. The \$1 million cleanup included dredging 15,000 cubic yards of sediment during the winter of 1992-1993. Post remediation monitoring is ongoing and includes water quality sampling, fish shocking, sediment chemistry, qualitative habitat assessment, and macroinvertebrate sample (WDNR, 1995).

Unnamed Tributary T7NR10E (Penitto Creek) This tributary to Upper Mud Lake, rising in section 14 T7N R10E, has poor habitat due to low flows, channel straightening and sedimentation from farm field and urban runoff. Despite the poor habitat, its Family Biotic Index (FBI) indicates "very good" water quality. This FBI score, coupled with growth of curly leaf pondweed and elodea, indicate groundwater discharge and cool water temperatures.

LAKES

Lake Monona drains a highly urbanized area and much of its shoreline has been developed. Water quality of this large drainage lake is affected by urban polluted runoff as well as the nutrient loading from Lake Mendota and its watershed. The Dane County Water Quality Management Plan prepared by the Dane County Regional Planning Commission provides more detail on nonpoint source pollution problems in the Yahara lakes.



Largemouth bass

Recreational use of Lake Monona is intense, with boaters, water skiers, sail boaters, wind surfers, anglers and swimmers taking advantage of the lake's attributes. The lake has a diverse fishery of perch, panfish, largemouth bass, northern pike, walleye and muskellunge. However, a fish consumption advisory exists for certain fish in the lake.

- *In-Lake Phosphorus Levels and Macrophyte Growth:* Herbicides and algacides have been used extensively--legally and illegally-- to combat algae blooms and excessive aquatic plant growth. The algae blooms and excessive plant growth are not a new phenomena: algae blooms were reported as early as 1888 and chemical treatment with copper sulfate to control algae was begun in 1918. At one time the city of Madison discharged wastewater effluent into the lake. That point source was eliminated with the construction of the Nine Springs wastewater facility, which discharges to Badfish Creek. Consequently, phosphorus levels have decreased in Lake Monona and water quality has improved. Improved water clarity, however, has stimulated increased aquatic plant growth.



Eurasian watermilfoil: flowering

Abundant rooted aquatic plant growth has historically occurred in Lake Monona, particularly in Monona Bay and Turville Bay. Eurasian water milfoil (*Myriophyllum spicatum*), a non-native aquatic plant having less fisheries value than native plants, invaded the lake in the last 50 years. The density of plant growth declined during a period in the late 1970s due to generally poor water clarity and dense summer algae blooms. In the 1980s aquatic plant growth, particularly milfoil, has been resurgent due to improved water clarity. During summer 1996, curly leaf pondweed was observed in as great or greater numbers than Eurasian water milfoil. Because the lake's sediment contains large quantities of nutrients, milfoil and curly leaf pondweed growth will likely continue to be a problem, particularly if water clarity continues to improve.

Over the years Lake Monona has been treated with more than 1.5 million pounds of copper and arsenic compounds to manage aquatic plant growth. Analysis of the core samples indicates a similar trend of decreasing concentrations of these compounds in lake sediments. Chemical spraying to manage aquatic plants is now regulated by WDNR under Administrative Code NR 107, Aquatic Plant Management, to protect overall water quality and aquatic habitat.



Curly leaf pondweed

- *In-Lake Contaminant Concentrations:* Chloride levels in the lake have slowly increased since the 1960s. Chloride levels in Monona are higher than in Lake Mendota, reflecting the greater proportion of urban runoff received by Monona. Sodium levels have been relatively steady over the last 25 years. Continued increases of sodium and chloride levels could change the species of algae and aquatic plants found in the lake and is a concern.

Portions of the lake have been filled with sediment in the past. Some of this fill material may include toxic substances. Due to elevated levels of mercury in walleye samples, a fish consumption advisory exists. The city of Madison Public Health Department identified Starkweather Creek as one source of mercury contamination in the lake. The department conducted sediment core sampling in 1987 to identify the

extent of mercury and sediment in the lake. Recent core samples show decreasing mercury deposition over time. These decreasing concentrations indicate the possibility of reduced bioaccumulation in fish.

Polychlorinated biphenyls were detected in sediment samples collected in 1987, with the highest concentration located along the north shore of Monona Bay. The north shore of the bay is also a mercury hot spot. A possible source for the PCBs and mercury is a large storm sewer outfall near the sampling site. Arsenic and copper compounds were also measured in the core samples. Fish monitoring for PCBs and mercury through WDNR's fish consumption advisory program will continue indefinitely.



Northern pike

Upper Mud Lake This shallow, fertile 256-acre lake between Lakes Monona and Waubesa, Upper Mud is entirely surrounded by 1,000 acres of wetlands. In fact, the lake was formed by a railroad grade crossing a marsh at the inlet of the Yahara River to Lake Waubesa. The wetlands provide good spawning areas for northern pike in the Monona-Waubesa lakes and an excellent stopover for migratory waterfowl. The lake's watershed is 11.5 square miles, and contains portions of the town of Blooming Grove and the cities of Monona and Madison. Increased polluted runoff from new development is a concern that should be addressed.

One perennial stream (Penitto Creek) exists in this subwatershed. Past monitoring on the stream has identified the presence of *Gammarus* sp. indicating groundwater seepage and “very good” water quality based on a biotic index classification system (Marshall, 1990). a project to remove sediments and stabilize Penitto Creek is underway.

Dredging of wetlands associated with the construction of the South Beltline Highway in Monona and Madison altered Upper Mud Lake's fish habitat. A 25-acre wetland restoration project to mitigate wetlands lost or destroyed by the beltline project has been completed in the lake's watershed. Very good fishing has been reported in some of the deep holes left by the dredging.



Filamentous algae

Boat traffic through Upper and Lower Mud lakes between Lakes Waubesa and Monona is heavy during the entire open water season. Wetlands of Upper Mud Lake are negatively affected by fast boat traffic through the open water areas. Fast boat traffic degrades established wetland vegetation and stirs the lake's sediment which reduces water clarity and inhibits the establishment of wetland plants. Fewer wetland plants means fewer nutrients taken up by aquatic plants, and thus, more phosphorus and nitrogen are available for use by algae. The stirring of bottom sediment and degradation of wetland plants by boat traffic is a serious water quality issue that should be addressed. The Dane County Lakes and Watershed Commission worked to pass a proposal for a “no wake” zone on all Madison waterbodies within 200 feet of the shoreline. This proposal should be implemented as it would protect existing vegetation, reduce accidents and hazards in nearshore areas, reduce shoreline erosion, and maintain or help improve water quality.

A pothole wetland located near the northeast corner of the intersection of Vondron and Femrite Roads was identified as a high quality wetland by the 1990 UW-Water Resource

Management Workshop. Migratory waterfowl make use of the lake and its wetlands in spring and fall. Because of its location between Monona and Waubesa, the fish consumption advisory should probably be observed on this lake as well.

In the stretch of the Yahara River connecting Upper Mud Lake to Lake Waubesa, which is located in the town of Dunn, archaeologists have identified the “Dyreson Fish Weir,” a structure constructed by prehistoric Native Americans that may be associated with a mound-building culture known to exist on the adjacent banks at one time. This site is currently being nominated for inclusion on the National Register of Historic Places and is only one of 10 known ancient fish weirs in the state.

Lake Waubesa is the shallowest of the Yahara Lakes. The watershed surrounding Lake Waubesa is a combination of urban, industrial, and rural lands. There are also extensive wetlands at the north and south ends of the lake. Lake Waubesa was severely affected by large amounts of municipal wastewater received during the 1940s and 1950s.



Eurasian watermilfoil closeup

Water quality of the lake has improved since MMSD diverted its treated wastewater effluent away from the lake. The lake still receives large nutrient loads primarily from upstream. The lake also continues to exhibit effects from past nutrient loading. Dissolved reactive phosphorus and total phosphorus levels in the lake have, however, declined, which may be attributed to reduced direct loadings from its watershed and indirect loads from upstream lakes. Lake sediments also contain high concentrations of phosphorus and will continue to affect water quality in the years to come.

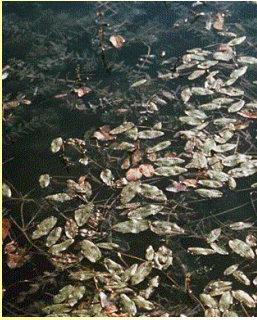
Rooted aquatic plant growth, particularly Eurasian water milfoil, has been resurgent in the lake, corresponding to improved water clarity. As with other lakes in the system, chloride levels in Waubesa have increased over the past 20 years. The lake flushes about two to three times per year.

A fish consumption advisory exists for walleye. Elevated levels of mercury were found in some fish samples taken by WDNR. Lake sediment sampling in 1987 indicates a trend toward decreasing mercury concentrations and deposition in the lake. Fish sampling for mercury will continue. WDNR received complaints from anglers of “cancerous” and “ulcerated” fish taken on the lake. Concerned that toxics leaking from the MMSD lagoons to Nine Springs Creek and entering the lake, WDNR staff investigated the reports and now believe these fish were suffering from naturally-occurring diseases, “red sore” disease in black crappie and lymphocysts in walleye. Additional fish samples were taken on Lake Waubesa in the fall of 1989 for further analysis. WDNR is investigating a connection between red sore disease and pseudomonas bacteria. Red sore tends to occur in fish under some stress, and occurs more frequently in the lower Yahara lakes.



Walleye

Lake Waubesa supports a productive and diverse warm water fishery of muskellunge, northern pike, walleye, bass and panfish. The lake receives heavy use, particularly for fishing. Rough fish are an ongoing problem. In 1995, a cooperative effort to restore eight acres of wetlands at the south end of Lake Waubesa neared completion. The wetlands are designed to trap soil from surrounding uplands, create fish spawning habitat, and enhance the lake's general ecological health.



Pondweed and milfoil dominate

Lake Wingra is a shallow 345-acre lake within and adjoining the University of Wisconsin Arboretum. Along its shoreline, Wingra is fed by seeps and springs which offer a diversity of wetlands and wet forest systems along the lake's southern border, including spring-fed tamarack stands, deep water cattail marsh, fen, wet meadow, oak savannah, and second-growth maple forest. The lake's maximum depth is 21 feet and mean depth, 8 feet. Wingra does not stratify and in 1980 was approximately one-third or more covered by Eurasian water-milfoil, an aggressive non-native water species.

One of Wingra's principal wetlands is Gardner Marsh, located in the northwestern portion of the UW-Madison Arboretum. Manipulations made to Murphy Creek's outlet to the lake in the early 1900s and the construction of Arboretum Drive isolated Gardner Marsh from Lake Wingra. The marsh is currently overrun by an invasive cattail hybrid (*Typha X glauca*) with only small patches of remnant sedge meadow. Changes in lake habitat and increased numbers of insect-feeding fish have decreased zooplankton and aquatic insect populations over time (DCRPC, 1988) and today the lake's fishery is dominated by stunted panfish and common carp. Muskellunge have been stocked with the hope of controlling panfish populations.



Common carp

Wingra has been adversely affected over the years by alterations of the lake and surrounding wetlands, and by urban stormwater. The impact of urban stormwater is perhaps best reflected by chloride levels twice as high as in Lake Monona. Sodium levels in Lake Wingra are about 75 percent higher than the levels in Lake Monona (The Fishery of the Yahara Lakes). Some water quality improvements have been made in the lake's eutrophic condition over the years, mainly from the diversion of wastewater and other effluent loadings of nutrients around the Yahara River chain of lakes, yet the lake remains shallow, highly turbid and fertile. Purple loosestrife has also invaded the lake, crowding out more desirable wetland vegetation. Fisheries management staff observed, however, a number of native plants growing in the lake's southeast bay in the summer of 1996. Proposed management actions within the coming years include: rerouting a major storm sewer outfall through HoNeeUm pond; carp removal; wild rice reintroduction; and recoupling Gardner Marsh to the lake (Lathrop, 1996).

Lake Wingra was identified in 1997 as a Lower Rock River Basin Integrated Ecosystem Management (IEM) project. As such, a variety of monitoring and coordination activities are planned for the lake in an effort to improve or restore the system's ecological functions.



Redwing blackbird perched on a cattail

A number of research projects sponsored by Edgewood College and others, and conducted by the Heron Institute--a K-12 educational program--are underway on the lake: the effect cutting the woody, invasive red osier dogwood on emergent wetland vegetation; red-winged black birds as wetland indicator species; comparative study between Lake Wingra and Dunn's Prairie Pond, a sediment detention pond; the lake's bluegill population; and zooplankton populations and behavior (Bohanan). Lake Wingra is also a UW Center for Limnology Long-Term Ecological Research lake and has also been studied under the International Biological Program (see "Lake Wingra, 1837-1973: A Case History of Human Impact," Baumann et al.).

WETLANDS



Lesser fringed gentian

Lake Waubesa Wetlands More than 500 acres of wetlands exist in the Lake Waubesa watershed. The lake's southern wetlands provide excellent habitat for fish spawning, migratory waterfowl and other wildlife and has a diversity of plant communities. Much of the wetland is in public ownership. A number of springs in and around the wetland provide a constant source of clean water. The primary threats are from alterations of some of the springs, agricultural polluted runoff, and local development and construction. The lake's 139-acre southeast wetland was identified by the 1990 UW-Madison Water Resources Monitoring Workshop as having significant aesthetic and recreational qualities.

Upper Mud Lake Wetlands (see also Upper Mud Lake) This wetland complex lies on either side of Upper Mud Lake between Lakes Waubesa and Monona. Portions of the original marsh have been filled in for development or have been otherwise disturbed by urban activities; other parts show evidence of past attempts to drain it. In the late 1980s the Wisconsin Department of Transportation (DOT) built a six-lane highway through a portion of the marsh to ease traffic congestion. The construction resulted in some wetland destruction, but other wetland areas were restored (about 25 acres) or created to compensate for the areas lost. Studies have shown, however, that the type of wetland lost, primarily wet meadow, have been replaced or mitigated with deep water marsh. These different habitat types support different wetland plants and perform somewhat different functions.



The Upper Mud Lake wetlands complex is diverse, ranging from shallow marsh with large monotypic cattail stands, to disturbed wet meadows with shrub willow stands. The large monotypic cattail stands may not provide adequate spawning areas for northern pike. A number of waterfowl/wildlife ponds were constructed as part of DOT mitigation to increase habitat diversity. Some of these ponds have been adversely affected by polluted urban runoff. The most serious threat to wetland water quality in the Upper Mud Lake complex is from construction site erosion and urban stormwater runoff from the South Beltline and the city of Monona.

Dunn's Marsh is an isolated 30-acre, deep-water marsh surrounded by a narrow strip of disturbed sedge meadow. A 1974 report states that the marsh is likely a discharge area that supports a large variety of nesting and migrant birds (Bedford). The report noted that increased surface water flow and sediment loading to the marsh from the surrounding developing areas were beginning to affect conditions within the marsh. The report recommended actions that could be taken to protect the marsh.



Dunn's Marsh

Today, Dunn's Marsh receives stormwater runoff from developed areas in Fitchburg and Madison to the north and west of the marsh, as well as from developed and developing areas in Fitchburg south of the marsh. The time of concentration of stormwater runoff is now much shorter due to the significant amount of impervious surfaces in the watershed. This has led to water quality and ecosystem degradation due to unnaturally high water levels and deposition of sediments and other pollutants. The cities of Madison and Fitchburg cooperated to have a study done of the Dunn's Marsh watershed in 1994, funded in part through the Yahara-Lake Monona Priority Watershed Project. The report generated by the 1994 study looked at



Upper Greene Prairie

existing conditions in the watershed, the marsh, and the channel draining from the marsh to the east which becomes Nine Springs Creek and at water quality and quantity problems in the marsh and in the downstream channel. It recommended a number of measures that would protect and enhance Dunn's Marsh, improve channel flow downstream of the marsh and protect downstream water bodies (R.A Smith & Associates). The city of Madison has undertaken a project to manage water levels of the marsh. This will mimic water level variations that a "normal" pothole deep-water marsh experiences. Other suggested activities in the area include increasing stormwater flow lengths prior to entering the marsh, establishing new detention basins, and improving the flow characteristics of the channel downstream of the marsh.

Downstream of Dunn's Marsh, the Greene Prairie portion of the University of Wisconsin Arboretum has seen increased stormwater on parts of the prairie. This is resulting in reed canary grass (*Phalaris arundinacea*), an undesirable exotic, invading portions of the prairie. Improving the hydraulics of the channel downstream of Dunn's Marsh may help the Arboretum in controlling the invasive species and restoring Greene Prairie. Another threat to the Arboretum is the 73-acre Harlan Hills development south of the Arboretum. Stormwater runoff from this development, is likely to have an adverse impact on the Arboretum physically and aesthetically. The UW-Arboretum and UW-Foundation, with the city of Fitchburg, Dane County, local environmental groups and local citizens were unable to acquire this parcel of land and put it into conservancy in order to protect the Arboretum.



Nine Springs E-way extends west to Dunn's Marsh. For more information see the Nine Springs E-Way Homepage at: <http://www.geocities.com/~vicsite/Eway/home.htm>

Nine Springs Wetland and E-Way Complex is located in the Nine Springs valley, which extends from Lake Waubesa on the east to Dunn's Marsh on the west. A number of springs and seeps in the valley, for which the area is named, feed the wetlands. As of 1998, about 33 percent of the more than 8,000-acre watershed was developed. The extensive Nine Springs wetland complex has been altered over the years by attempts to drain portions and by channelization of the stream and some of its spring-fed tributaries. It is the recipient of stormwater carrying construction site sediment and other pollutants from the cities of Madison and Fitchburg. These changes have altered the vegetative composition of the wetland with exotic species such as reed canary grass invading and becoming dominant. There are still some relatively undisturbed areas of sedge meadow and shallow water marsh. The wetland complex is home to a large number of amphibians, birds and animals.

The most significant features of the wetland complex are the springs and groundwater seeps. Some of the original springs in the area no longer exist due to development. Groundwater modeling in 1995 and 1996 suggests the four main springs have a local rather than a regional source for their water. This means that further urbanization without consideration of the recharge areas for these springs could reduce spring flows. This could have a serious impact on WDNR's Nevin Fish Hatchery, which relies on spring flow in its operation. The Nine Springs Watershed and Environmental Corridor report goes into greater detail on existing conditions of the wetland and recommends protecting and enhancing the wetland complex. The Nine Springs wetlands are within the project area of Dane County's Nine Springs E-Way corridor. As a result, much of the wetland falls under public ownership by either Dane County, the cities of Madison and Fitchburg, and WDNR.



Lake herring

Resources of Concern (LR08)

WDNR's Heritage Resources Database indicates that the following water-dependent endangered, threatened or special concern species and/or communities have been sighted in this watershed within the last 20 years.

Table 2. Endangered, Threatened or Species of Special Concern

Species	Latin Name	Habitat
Lake Herring	<i>Coregonus Artedi</i>	Lake Monona (1977)
Lake Sturgeon	<i>Acipenser Fulvescens</i>	Lake Monona (1978)



Table 3. Endangered, Threatened or Communities of Special Concern

Plant Community	Location	Indicator Species/Description
Southern Sedge Meadow, Shrub-Carr, Stream--slow, hard, warm	Nine Springs Meadows	Area of good sedge meadow and many springs, with some shrub carr, along Nine Springs Creek. Portions of the tract are privately owned.
Lake-shallow, hard, drainage, Emergent Aquatic, Southern Sedge Meadow, Wet Mesic Prairie	Dunn's Marsh	This shallow pond and deep water marsh is an important surface water source for the Nine Springs Valley. Some erosion and siltation from residential development to the north has occurred. Marsh of cattail, arrowhead, bur reed, and sedges surrounds the open water. Remnant low prairie with young burr oaks also is present. Land ownership is divided between the cities of Fitchburg and Madison, and Dane County. Area is used for education and research.
Southern Sedge Meadow, Calcareous Fen, Springs and spring runs-hard	South Waubesa Wetlands	Waubesa wetlands is part of a 450-acre wetland on the southwest side of Lake Waubesa. Many springs and spring runs are present, particularly at the marsh edge, and many feed Swan and Murphy's creeks, which flow through the marsh. Most of the wetland is a sedge meadow with emergent aquatic and fen species present. A portion of the area is owned by the Nature Conservancy.
Southern Dry Mesic Forest, Dry Prairie	Observatory Woods (UW-Arboretum)	Continuum from moist red oak woods to dry forest to oak savanna and dry prairie. Fire used to manage prairie remnant. Soils vary from 3-6 inch layer on dry sites to deeper Knox silt loam where the Mendota limestone is at a greater depth.
Calcareous Fen, Springs and Spring Runs, hard	Wingra Fen	Area features a small fen at the base of a hill which slopes gently to the shore of Lake Wingra. A spring emanates from the base of the hill. Area invaded by woody species. Numerous research projects take place here.
Southern Dry Mesic Forest	Heritage Heights Woods	This dry mesic woods is unusual in that it contains a very species-diverse tree canopy. Despite its small size and the edge effect, the woods retains a rich ground flora. No spring ephemerals are present; the site does contain diverse flora.



Prairie controlled burn

Plant Community	Location	Indicator Species/Description
Lake, Emergent Aquatic, Southern Sedge Meadow	Upper Mud Lake	Upper Mud Lake, a widening of the Yahara River, is surrounded by an extensive area of shallow marsh and sedge meadow. The major features of the area are its large size, scenic values, and wildlife habitat. Portions of the marsh are disturbed by ditching, filling and the south beltline.

RECOMMENDATIONS



Upper Greene Prairie

Dane County Regional Planning Commission has developed specific nonpoint recommendations for communities in Dane County in the Yahara Monona Priority Watershed Project Plan (1992). This list should also be considered by communities when planning water quality work and budget items.

1. The Lower Rock River Basin Team should conduct fish monitoring in Lake Waubesa, the Yahara River, and Lake Monona for mercury. ¹
2. The Lower Rock River Basin Team should monitor carp in the watershed for PCBs. ¹
3. The Lower Rock River Basin Team should conduct additional sediment core sampling in Lake Monona and Lake Waubesa to identify possible trends in PCB contamination. ¹
4. The Lower Rock River Basin Team should conduct a more complete assessment of in-place pollutants in Monona Bay by expanding sediment sampling to areas not previously sampled. ¹
5. The Lower Rock River Basin Team, Dane County, the cities of Madison and Monona, and the village of McFarland should consider a project to supplant exotic rooted aquatic plants with native species in Lakes Monona and Waubesa. ^{1,2}
6. The cities of Madison, Monona and Fitchburg, and Dane County, should improve enforcement of their construction site erosion control ordinances. ²
7. Dane County should work with WDNR to establish water levels that accommodate northern pike spawning habitat and improved water quality on tributaries to the Madison Lakes. ^{1,2}
8. Dane County and the city of Madison should expand upon Dane County's existing 200-foot no wake ordinance for Upper Mud Lake's open water and wetlands areas to improve water quality and maintain wetland functional values. ²
9. All communities in the watershed should develop and implement comprehensive stormwater management plans that emphasize conservation design stormwater principles. ²





Broadleaved cattail

10. WDNR's Long-Term Trend lake sampling protocol should be used in the monitoring of lakes Monona and Waubesa.^{1,2}
11. The city of Fitchburg, with the assistance of the Dane County Regional Planning Commission, WDNR, the Wisconsin Geological and Natural History Survey, and the U.S. Geological Survey, should identify local groundwater recharge areas supporting the springs and seeps in the Nine Spring wetlands and develop strategies to protect these areas.²
12. Dane County, the cities of Madison and Monona, and the village of McFarland should take advantage of federal, state and private funding opportunities to acquire additional public access and lands on Lake Monona, Upper Mud Lake and the Yahara River.²

1. These recommendations are a basis for work planning or other decisions, which must be approved by the appropriate DNR division administrator (the recommendations are a starting point for the work planning process).

2. These recommendations are advisory to the public, local governments, lake management organizations, and other groups or agencies. These recommendations are not binding. No statutory or codified requirements exist

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Shrub carr with red osier dogwood in the midground

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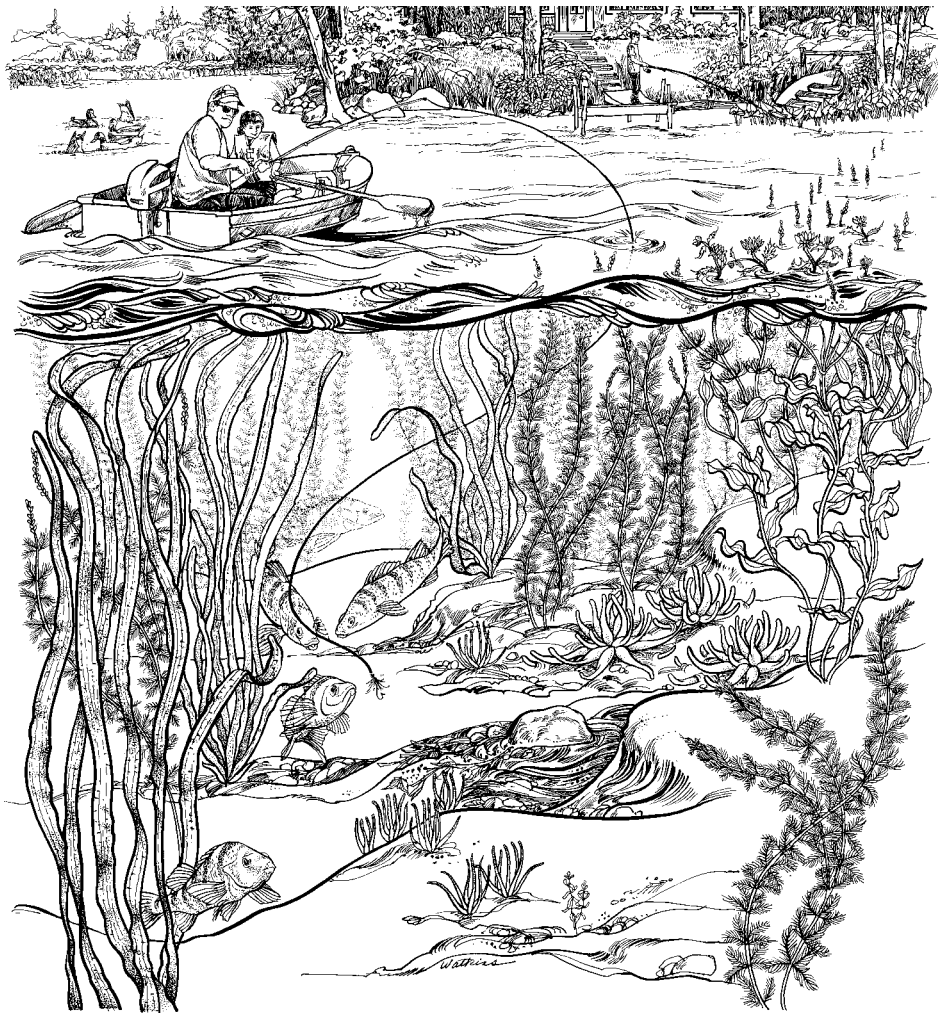


Table 4. Streams in the Yahara-Monona Watershed (LR08)

Stream Name	WBIC	County	Length (Miles)	Existing Use (Miles)	Potential Use (Miles)	Supporting Potential Use (Miles)	Current Codified Use	303(d) Status	Use Impairment		Data Assessment	Data Level	Trend	References
									Source	Impact				
Murphy (Wingra) Creek	0804700	Dane	2	WWSF/2	Same	Part - Thr	WWSF*	Y (miles 0 - 1.2)	HM, DEV, URB, PSI	DO, FLOW, HAB, TOX, TURB, FKILL, MAC, TEMP, NUT, SED, MIG	E	B2 H1 C2 T2	D	3, 6, 10, 13, 16, 17, 23, 26, 29, 30, 31, 34, 40, 65, 78, 88
Murphy's Creek	0803900	Dane	3	WWFF/3	Same	Part	WWSF*	N	HM, NPS, CE, URB	FLOW, TURB, DO, TEMP, HAB, SED, NUT	M	B2 H2 C1	S	10, 13, 51, 17, 23, 40, 63, 65
Nine Springs Creek	0804200	Dane	6	WWSF/6	Same	Part - Thr	WWSF*	N	DEV, HM, SB, CE, RS, URB, PSM	HAB, TURB, DO, TEMP, NUT, SED, FLOW, MAC	M	B2 H2 C3	S	6, 10, 12, 13, 17, 23, 34, 40, 63, 67
Starkweather Creek	0805100	Dane	3	LFF/3	WWSF/3	Not	WWSF*	Y	DEV, HM, CE, URB, PSI, CL	DO, FLOW, HAB, TOX, TURB, SED, FKILL, NUT, SC, TEMP	M	B2 H2 C2 T3	S	6, 10, 13, 17, 19, 23, 30, 31, 34, 40, 42, 63
Swan Creek	0803800	Dane	2	WWFF/2	UNK	UNK	WWSF*	N	HM, NPS	FLOW, HAB, TEMP, DO, SED, NUT	M	B2 H2 C1	U	10, 13, 17, 23, 34, 40, 78
Yahara River	0802200	Dane	2	WWSF/2	Same	Part - Thr	WWSF*	N	HM, CE, URB	HAB, TURB, SED, NUT, MIG, FLOW, DO, TEMP	M	B2 H2 C2 T3	S	10, 12, 13, 17, 23, 40
Unnamed Creek- tributary to upper Mud Lake	0804100	Dane	3	LFF/3	Same	Part	WWSF*	N	HM, NPS, CL, CE, URB	DO, FLOW, HAB, TURB, NUT, TEMP, SED	E	B2 H1 C1	U	6, 10, 12, 23, 34
Unnamed Streams			8											

Table 5. Lakes in the Yahara River/Lake Monona Watershed (LR08)

Lake Name	County	Town, Range, Section	WBIC	Surface Area (Acres)	Max Depth (ft)	Mean Depth (ft)	Lake Type	Winter kill	Access	SH	Hg	Mac	LMO	TSI	TSI Class	Lake Plan Prot	P Sens	Impairment		Comments
																		Source	Impact	
Lake Monona	Dane	T07NR10E S20	0804600	3,274	64	27	DG	N	BR	X	GA*	EM PL	X	54***	EU	PRT PLAN	I B	URB, NPS, DEV	NUT, HAB, TOX	--
Lake Waubesa	Dane	T06NR10E S03	0803700	2,080	34	16	DG	N	BR	--	GA	EM	Y	56***	EU	PLAN	II B	NPS, CE, URB	NUT, MAC, HAB, TOX	--
Lake Wingra	Dane	T07NR09E S27	0805000	345	21	--	DG	N	BR	X	GA	EM	Y	57***	EU	PLAN	II B	NPS, CE, URB	NUT, MAC, HAB	--
Upper Mud Lake	Dane	T07NR10E S28	0804000	223	8	4	DG	N	W	--	GA	--	--	--	EU	PROT	II B	URB, DEV	NUT, TURB, MAC, HAB	--

* Lake Monona has a carp advisory that limits consumption of carp to 1 serving/month for men and women due to PCB contamination.